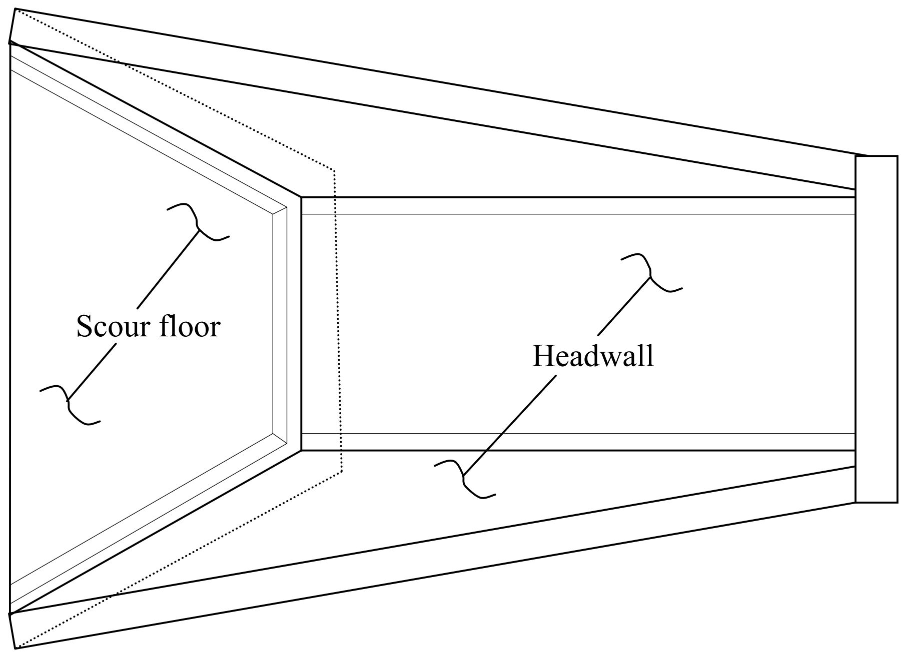
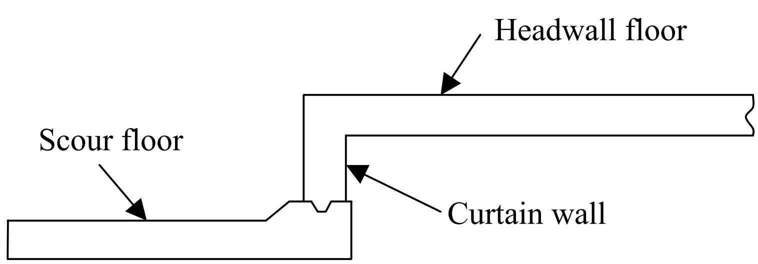
Typical RCB Scour Floor

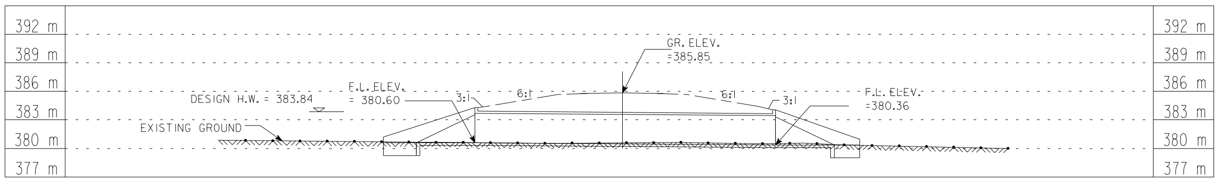


Plan view



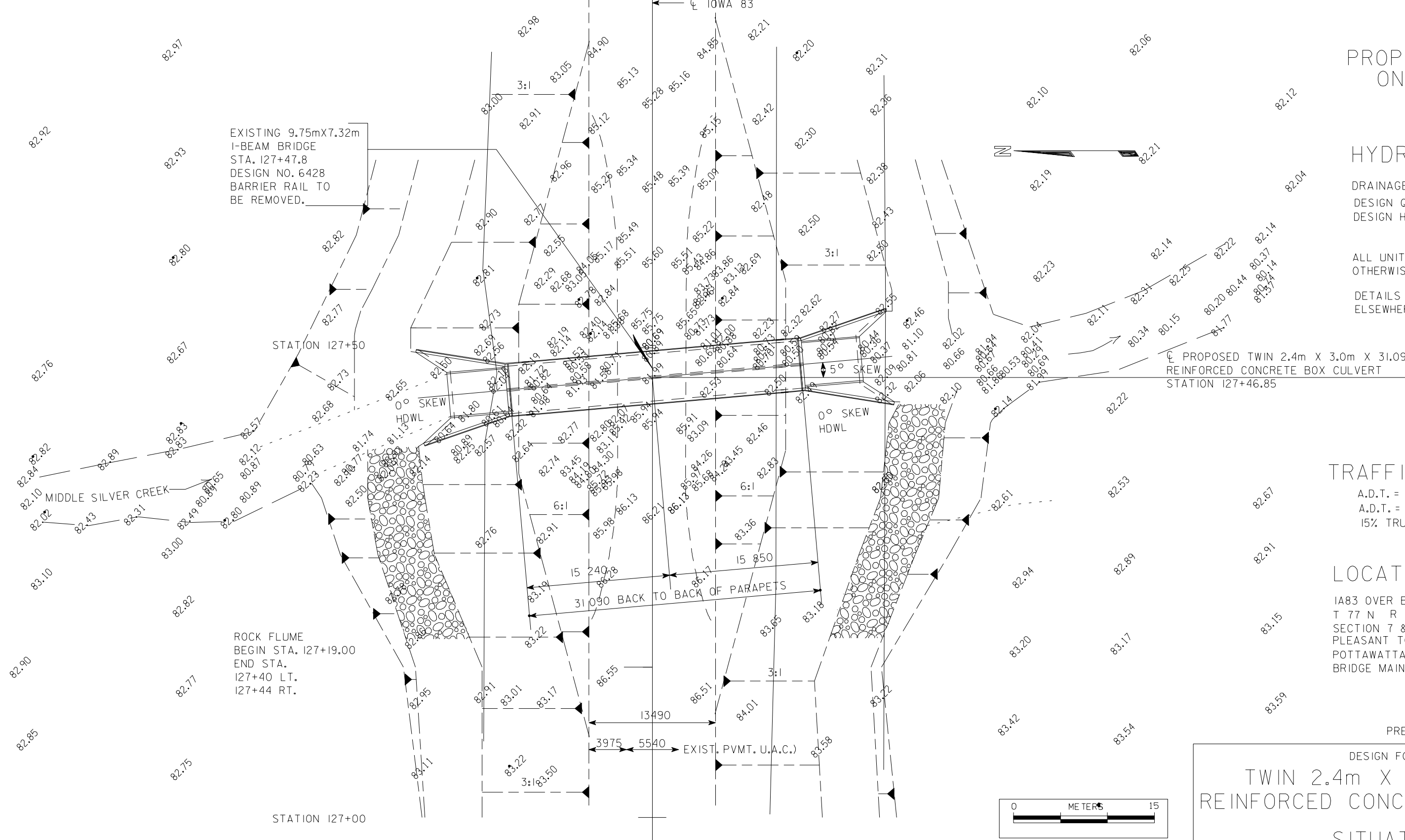
Section through scour floor

BM NO. 513 STA. 127+ 49.735, 4.071 RT FD "X" TOP SO. HNDRAIL CENTER BRIDGE ELEV. 386.841



LONGITUDINAL SECTION ALONG ℄ CULVERT

ANTICIPATED SETTLEMENT =



SITUATION PLAN

PROPOSED GRADE ON IA 83

(U.A.C.)

HYDRAULIC DATA

DRAINAGE AREA= 573.9 Ha H
DESIGN Q50 = 44.04 CMS
DESIGN HIGH WATER ELEV. = 383.84

ALL UNITS ARE IN mm UNLESS OTHERWISE NOTED.

DETAILS FOR THE ROCK FLUME SHOWN ELSEWHERE IN THE PLANS.

TRAFFIC ESTIMATE

A.D.T. = 525 VPD (2001)
A.D.T. = 2021 VPD (2021)
15% TRUCKS

LOCATION

IA83 OVER BRANCH OF MIDDLE SILVER CREEK
T 77 N R 40 W
SECTION 7 & 18
PLEASANT TOWNSHIP
POTTAWATTAMIE COUNTY
BRIDGE MAINT. NO. 7807.0S083

PRELIMINARY

DESIGN FOR 5° SKEW (R.A.)

TWIN 2.4m X 3.0m x 31.09m REINFORCED CONCRETE BOX CULVERT

SITUATION PLAN

STATION: 127+46.85 X

POTTAWATTAMIE COUNTY

IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION

DESIGN SHEET NO. ____ OF ____ FILE NO. 29412 DESIGN NO. 100

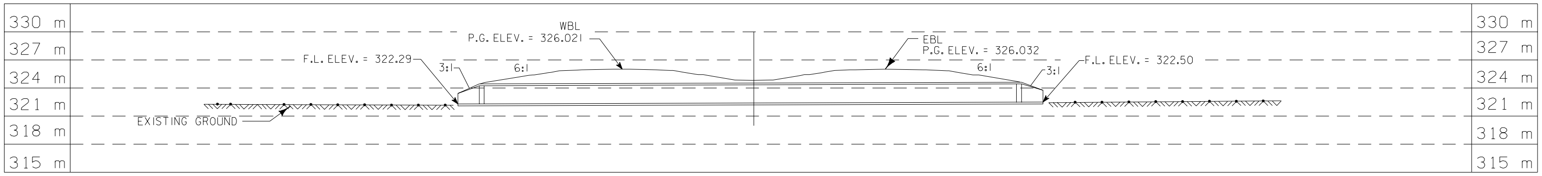
DESIGNED BY ____ CHECKED BY ____
DETAILED BY ____ CADD FILE ____

POTTAWATTAMIE COUNTY

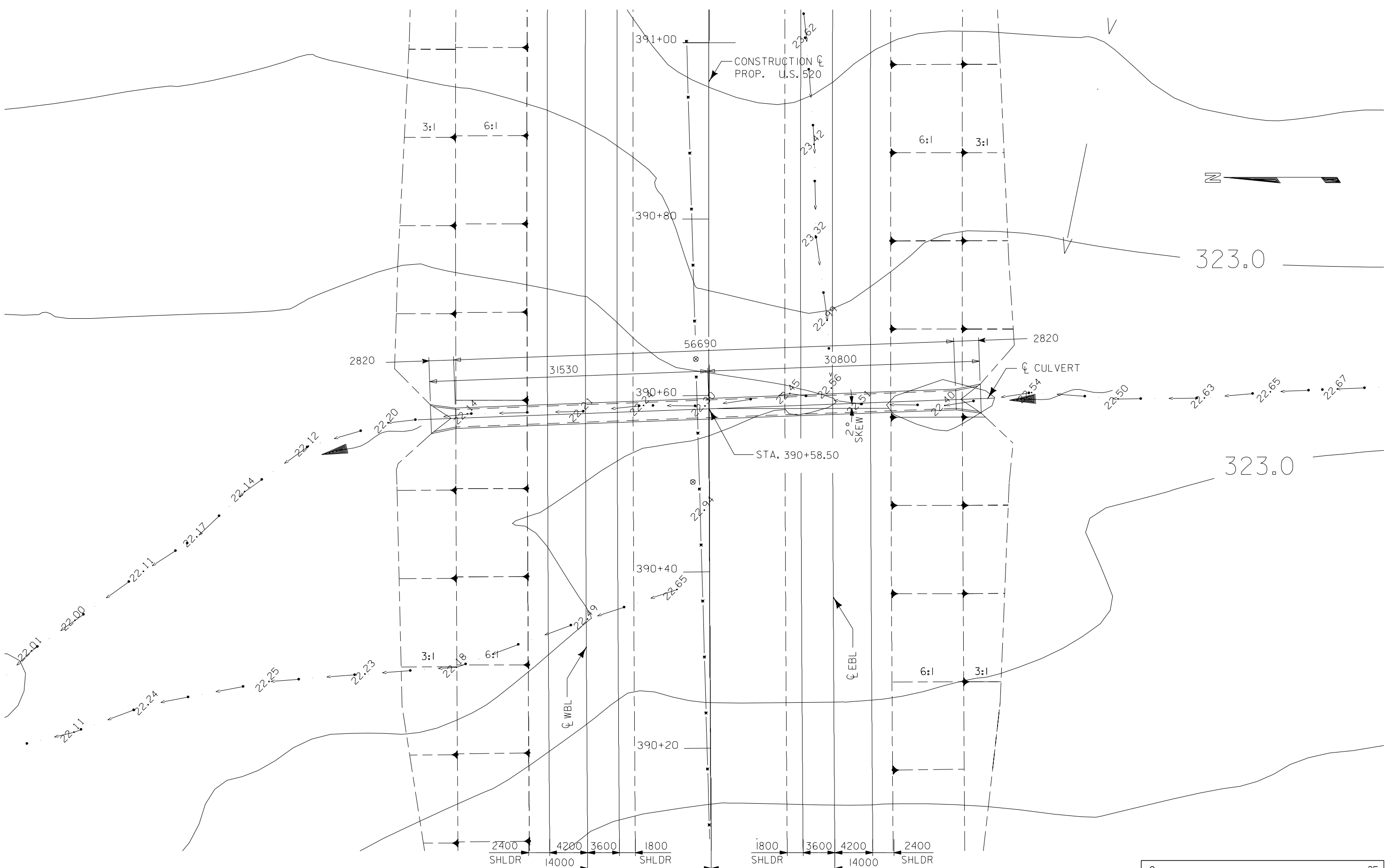
PROJECT NUMBER BRF-83-0(26)--38-78

SHEET NUMBER

XXXXXXXXXSYSTEMTIME XXXXXXXUSERNAME XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXDGNSPEC



LONGITUDINAL SECTION ALONG CENTERLINE PIPE



PLAT PLAN

LOCATION

T-88N R-19W
SECTION 10
CLAY TOWNSHIP
HARDIN COUNTY

PRELIMINARY
DESIGN FOR 2° SKEW (R.A.)

1950 mm x 56.69 m REINFORCED CONCRETE PIPE

PLAT PLAN

STATION: 390+58.50 X

HARDIN COUNTY

IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION

DESIGN SHEET NO. 1 OF 1 FILE NO. ______ DESIGN NO. ______

DESIGNED BY ______ CHECKED BY ______ DETAILED BY ______ CADD FILE ______	METRIC	IOWA DOT * OFFICE OF DESIGN	HARDIN COUNTY	PROJECT NUMBER NHS-520-5(39)--19-42	SHEET NUMBER

XXXXXXXXXXSYSTEMTIME XXXXXXXUSERNAME XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXDGNSPEC

Checklist for Situation Plans for Box Culverts

General

_____ Benchmark description
_____ Vertical curve data
_____ Horizontal curve data
_____ Traffic estimate
_____ Hydraulic data table including Drainage Area, Q_{50} cfs (cms), and Design High Water Elevation. For Large Culverts (20 ft. (6.1 m) span or longer structures) <u>also</u> include Q_{100} cfs (cms) and Q_{500} cfs (cms) or Roadway Overtopping Q.
_____ Location table
_____ Size in Title Block
_____ Skew angle of actual design shown in Title Block
_____ Project number, file number, design number, CADD file name
_____ Scale bar (shown on the preliminary Situation Plan but will be removed in Final Design during the development of the final Situation Plan).
_____ North arrow
_____ Staging details
_____ DNR or 404 Permit numbers
_____ Engineering certification notes and signature for structures needing DNR Flood Plain Permit
_____ Note: "All units are in XXX unless otherwise noted."

Plan View

_____ Label "Situation Plan"
_____ Ground elevations, contours, and topography. Label contour elevations.
_____ Existing utilities, fencelines, tiles, etc.
_____ Existing structures, including description and design number, if known
_____ Proposed length (back-to-back of parapet)
_____ Proposed station on road construction centerline
_____ Skew angle of culvert to road
_____ Skew of headwalls, if different than skew to road
_____ Proposed lane and shoulder widths
_____ Proposed embankment and ditch shaping
_____ Label all centerlines
_____ Label stationing on at least two "tic" marks in the plan view
_____ Future proposed work by others (e.g., bike trail, ramp, etc.)
_____ Stream name and direction of flow
_____ Location and designation of soil test holes
_____ Check that all text and dimensioning is legible and not placed on top of other text or features such as riprap details or contour lines
_____ Label type, location and limits of features such as riprap and channel changes. Provide typical cross section.

Longitudinal Section

_____ Roadway section drawn perpendicular to road
_____ Projection is along centerline of culvert (therefore, true length not shown for skewed culverts)
_____ Existing ground line and proposed grade line shown and labeled
_____ Existing structure
_____ Proposed flowlines at inlet, outlet, or other features (slope taper, drop inlet, flume, etc.)
_____ Profile grade elevation at intersection of culvert and road centerline
_____ Berm slope labeled (e.g., 6:1, 3:1)
_____ Design highwater elevation

Checklist for Plat Plans for Pipe Culverts

General

_____ Material, type and size in Title Block
_____ Project number, CADD file name
_____ North arrow
_____ Staging details

Plan View

_____ Label "Plat Plan"
_____ Ground elevations, contours, and topography. Label contour elevations.
_____ Existing utilities, fencelines, tiles, etc.
_____ Existing structures, including description and design number, if known
_____ Proposed length, including dimensions needed for Typicals, e.g., lengths left and right, total length, dimensions A, B, C, etc.
_____ Proposed station on road construction centerline
_____ Skew angle of culvert to road
_____ Skew angle of extension to existing pipe, if other than 0 degrees
_____ Proposed lane and shoulder widths
_____ Proposed embankment and ditch shaping, including ditching inlet or outlet
_____ Label all centerlines
_____ Label stationing on at least two "tic" marks in the plan view
_____ Future proposed work by others (e.g., bike trail, ramp, etc.)
_____ Check that all text and dimensioning is legible and not placed on top of other text or features such as contour lines

Longitudinal Section

_____ Roadway section drawn perpendicular to road
_____ Projection is along centerline of culvert (therefore, true length not shown for skewed culverts)
_____ Existing ground line and proposed grade line shown and labeled
_____ Existing structure
_____ Proposed flowlines at inlet, outlet, or other breaks as needed for Typical
_____ Label degree of elbows
_____ Profile grade elevation at intersection of culvert and road centerline
_____ Berm slope labeled (e.g., 6:1, 3:1)

Determining Culvert Lengths

Required Length
The required length of a culvert is generally determined by one of two methods:

1. by the clear zone; or,
2. by fitting the culvert to the typical cross section, such as the barnroof.

Both methods must be checked and then compared; the **greater** of the two distances is the required culvert length.

The first method uses Table 3.1 from AASHTO's Roadside Design Guide, which gives a range of minimum clear zone distances which are acceptable for safety. This clear zone is measured from the edge of the driving lane to the back of the RCB parapet or the top opening of the pipe apron. (Note that the clear zone is measured from the edge of the driving lane [typically 3.6 m or 12 ft], not from the edge of any additional pavement that will be used as part of the shoulder.) Only in rare circumstances shall any replacement or extended culvert be shorter than required by Table 3.1. (One exception is the inlet end of a median drain with an apron guard.)

The second method computes the culvert length by fitting the culvert to the roadway barnroof section. In other words, the computed length is determined by intersecting the barnroof with the back of the RCB parapet or the top opening of the pipe apron. See "Determining Culvert Lengths Using the Computations Section on Pink Sheets" in this appendix for this method. This is the primary purpose of the Computations Section on the pink sheets.

To repeat the statement above, the **greater** of the two distances from these methods is the required culvert length.

Computations Section on Pink Sheet
The Computations section on the pink sheet should be used to determine the lengths of pipe and box culverts. The terms from the pink sheet are defined below to aid in the calculation of lengths based on the typical cross section (e.g., barnroof section) for a given project. The calculated length must be compared to the minimum length required by clear zone criteria. The greater of the two lengths will govern. See comments on line 12.

1. **Profile Grade -** Grade at a pre-determined station. Taken from the Road Plan and Profile sheet. If the structure is skewed, the Grade Rt and Lt could vary. Use the grade at the station where the parapet or top of pipe opening is perpendicular to road centerline.

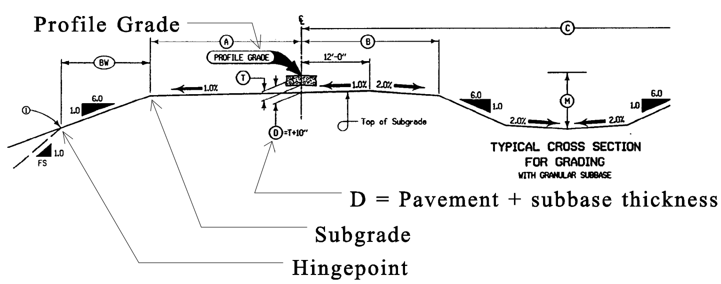
2. **Vertical Drop (Subgrade or Hinge Point) -** Vertical distance down from Profile Grade to Subgrade Point to Hinge Point. For any given project, the Vertical Drop generally stays constant except in areas with superelevations. See the following drawing that depicts the Vertical Drop and the Working Point Elevation.

3. **Working Point Elevation -** Line 1 minus Line 2.
Either the subgrade elevation or the hingepoint elevation is used as the Working Point Elevation. See the typical grading section below. Which point to use in the computation of

culvert length depends on the elevation of the top of the culvert. If the top of the pipe opening (or RCB parapet) is above the hingepoint elevation, then the subgrade is used as the working point. If the top of the pipe opening (or RCB parapet) is below the hingepoint elevation, then the hingepoint is used as the working point.

<u>Subgrade Elevation</u>
Profile grade elevation
-Pavement and subbase thickness
-Subgrade cross slope times distance (typically 1% X >A)
= Subgrade elevation

<u>Hingepoint Elevation</u>
Subgrade elevation
-BW (6:1 slope)
= Hingepoint elevation



4. **Flowline -** This is the actual proposed culvert flowline elevation, not the ground elevation.

5. **Difference** - Line 3 minus line 4 = vertical difference between the Working Point Elevation and the culvert Flowline Elevation.

6. **(D+T) or (H+Hdwl)**

   D + T (for pipes only) = Diameter of pipe + the thickness of pipe (see RF-1).

   H + HDWL (for RCBs only) = Nominal height of the box (e.g., 2400 mm) + the height of parapet (600 mm) and frost trough (100mm).

7. **Difference -** Height Difference (line 5) minus D+T or H+HDWL (line 6). Gives the actual vertical distance between the top of structure to soil at the working point (hinge point or subgrade).

8. **Slope -** Embankment Slope from the working point (subgrade or hinge point) to the top of pipe opening or parapet. The slope is generally 6:1 when using the subgrade as the working point or 3:1 when using the hingepoint.

9. **Working Point (Subgrade or Hinge Point) to End of Foreslope** - Line 7 multiplied by line 8 = the horizontal distance from the working point to the top of the pipe opening (or the RCB parapet).

1. **Distance = Centerline to Working Point -** On 2-lane roadways, this is the horizontal distance from the centerline of roadway (or survey centerline) to the working point (Subgrade or Hingepoint) used in calculating Vertical Drop on Line 2

   On 4-lane roadways, this is the horizontal distance from the construction centerline (typically the median) to the working point (Subgrade or Hingepoint).

11. **(1.5:1) or (Dimen. B) for pipes only -** Line 9 determines the culvert length only to the top of the pipe, so the distance from the top of the pipe to the end of the apron must be accounted for. For 1200mm or smaller pipes, use the "B" dimension of the pipe (see Road Standards); for 1350mm or greater pipes, use 1.5 x D. For box culverts, Line 11 is zero.

12. **Length -** This is the total calculated length of the culvert from the roadway centerline to either the end of the pipe or the back of RCB parapet. This is the sum of lines 9, 10 and 11. Then compare this calculated length to the minimum length to be sure it meets the minimum clear distance as follows:

    For RCBs, minimum length = Lane width + Clear zone
    For pipes, minimum length = Lane width + Clear zone + Apron >B= dimension

    Select the greater of calculated length or minimum length.

13. **Secant of Skew Angle -** If structure is skewed, list the secant of the angle the structure is to centerline of roadway.

14. **Length on Skew -** Line 12 times line 13 gives the actual length along the centerline of the culvert.

15. **Add for Hdwl Skew -** The length (line 12 or 14) of the structure is calculated along the centerline of the culvert. However, if the parapet of the headwall is not parallel to the roadway (e.g., a 0 degree skewed headwall with a 10 degree skewed barrel), then one corner of the headwall will fall closer to the roadway than the centerline of the culvert. This corner must be extended to equal the length that was calculated on the centerline (line 12 or 14). This situation will also pertain to all pipes; a length must be added to get the end of the apron beyond this point.

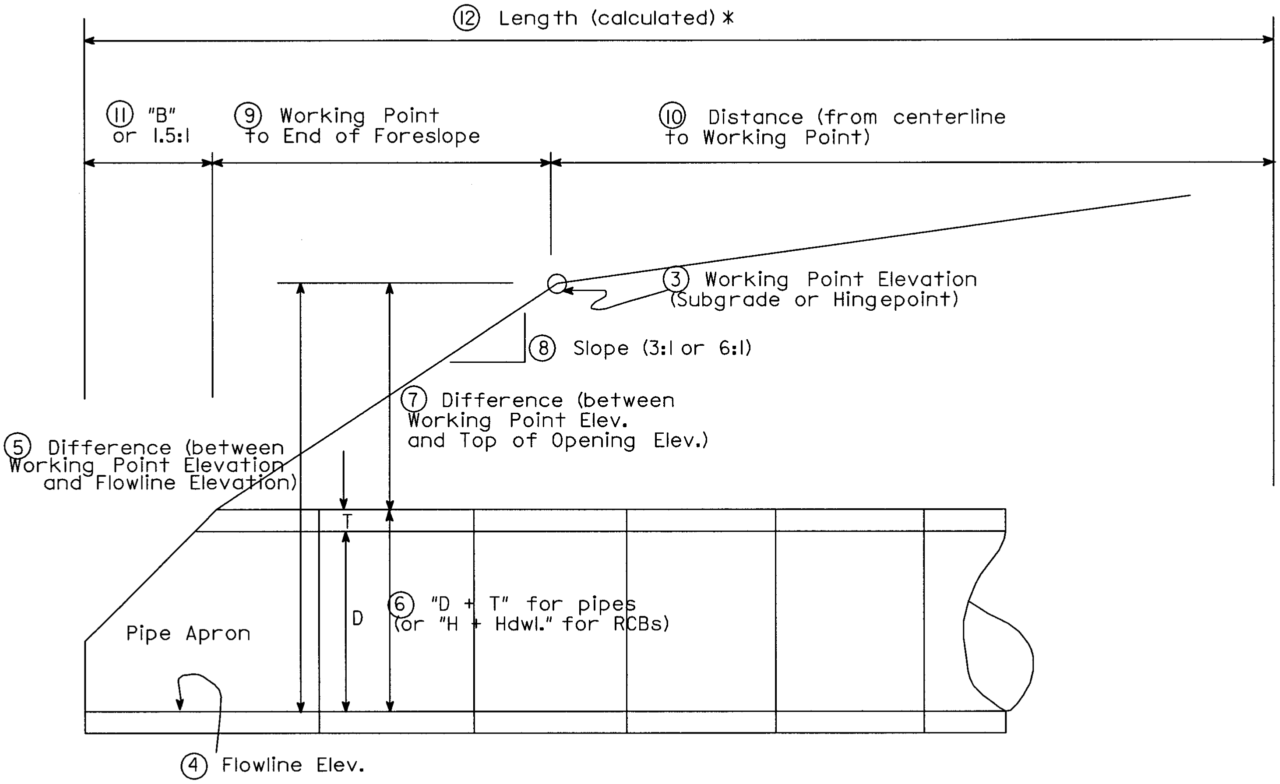
16. **Length -** Add "Length on Skew" (line 14) and "Add for Hdwl Skew" (line 15).

17. **Length Present Structure -** If designing an extension, determine the length of the existing structure from the road centerline to the front (not the back) of the RCB parapet

or to the first pipe barrel section.

18. **Extension -** Length (line 16) minus Length Present Structure (line 17). This gives the extension length needed.

Pink Sheet----Computations Section



* Compare calculated length to the "clear zone" minimum length. Use the greater length.

Sample Pink Sheet

Form 621001
3-93

Iowa Department of Transportation
Highway Division
Bridge Survey Record
FIELD NOTES FOR CULVERTS

Township 72N Range 11W Section 25 Civil Township Locust Grove
Station Present Structure or Stream — Station Proposed Culvert ~~344~~ + 70
Drainage Area in Acres 6 El. Hi. Water — Character Water Shed R
Upstream Land Use Cult. Anticipate Any Change? No
Bench Mark No. —
Type and Elev. of Low Upstream Buildings —
Present Structure: Type None Design No. ______ Br. Rdwy. ______
Spans ______ Ht. ______ Length: B. to B. Ppts. ______ Pipe ______ Flume ______
Elevation: Grade ______ Inlet ______ Outlet ______ Flume Outlet ______
Condition ______ Skew Angle ______
Proposed Culvert: Type 1501, RF-1 & CMP Fin. Rdwy. Width (Sh-Sh) 40'
Spans 24" Ht. — Length New Constr: ~~RCB~~ CMP 82' ~~Pipe~~ RF-1 60' + 1-RF-3 Aprons ~~Flume~~ 1-RF-5
Elevation: Profile Grade 731.20 F.L. Lt. 701.0 F.L. Rt. 725.4 F.L. Other 721.5, 702.1
Ext. Lt. — Rt. — Total Length Lt. 126' Rt. 46' Skew Angle 0 ~~(Lt.) (Rt.)~~ Ahead
— Contr. Dike — Sta. — El. — Type — Road Contr. Ditch outlet
Design Q 18 C.F.S. Frequency 50 Yr. Design High Water Elev. 728.1 Depth 2.7 Ft.
Design Fill Height 5 Ft. Pipe Class 2000 D. Class Bedding C — ADT = — VPD
Disposition of Present Structure —
Remarks A = 76', B = 60', C = 2', E = 20', Q = 6.5'
Two – 16° CMP elbows, One RF-2 Type C-3 adapter

Computations

	Left		Right	
1	Profile Grade Elev.	731.20	Profile Grade Elev.	731.20
2	Vert. Drop {Subgrade or / Hinge Point}	- 4.7	Vert. Drop {Subgrade or / Hinge Point}	- 1.9
3	Working Point Elev.	= 726.50	Working Point Elev.	= 729.3
4	Flow Line	- 701.0	Flow Line	- 725.4
5	Difference	= 25.50	Difference	= 3.9
6	(D + "T") or (H + Hdwl.)	- 2.3	(D + "T") or (H + Hdwl.)	- 2.3
7	Difference	= 23.2	Difference	= 1.6
8	Slope (6:1, 3:1, etc.)	× 3	Slope (6:1, 3:1, etc.)	× 6
9	Working Point to End of Foreslope	69.6	Working Point to End of Foreslope	9.6
10	Dist. = ¢ to Working Point	+ 48.0	Dist. = ¢ to Working Point	+ 28.0
11	(1½:1) or (Dimen. "B")	+ 3.6	(1½:1) or (Dimen. "B")	+ 3.6
12	Length, Calc. or Min (45.6) 12 + 30 + 3.6	121.2	Length, Calc. or Min (45.6) 12 + 30 + 3.6 =	~~41.2~~ 45.6 min.
13	Secant of Skew Angle	×	Secant of Skew Angle	×
14	Length on skew		Length on skew	
15	Add for hdwl. skew	+	Add for hdwl. skew	+
16	Length		Length	
17	Length pres. struct.	-	Length pres. struct.	-
18	Extension		Extension	

Sample Pink Sheet

Form 621001
3-93

Iowa Department of Transportation
Highway Division
Bridge Survey Record
FIELD NOTES FOR CULVERTS

Ramp "D"

Township 72N Range 11W Section 29 Civil Township Locust Grove
Station Present Structure or Stream — Station Proposed Culvert 4527 + 56.00
Drainage Area in Acres 14 El. Hi. Water — Character Water Shed F
Upstream Land Use Cultivated Anticipate Any Change? No
Bench Mark No. —
Type and Elev. of Low Upstream Buildings —
Present Structure: Type None Design No. ____ Br. Rdwy. ____
Spans ____ Ht. ____ Length: B. to B. Ppts. ____ Pipe ____ Flume ____
Elevation: Grade ____ Inlet ____ Outlet ____ Flume Outlet ____
Condition ____ Skew Angle ____
Proposed Culvert: Type 1201 RF-1 Fin. Rdwy. Width (Sh-Sh) 26'
Spans 24"Ø Ht. — Length New Constr: RCB — Pipe 94' + 2 Aprons Flume —
Elevation: Profile Grade 756.45 F.L. Lt. 748.4 F.L. Rt. 740.8 F.L. Other 741.1
Ext. Lt. — Rt. — Total Length Lt. 50' Rt. 56' Skew Angle 20° ~~Lt.~~ Rt. Ahead
Road Contr. Dike Lt. Sta. 4527+70 El. 751.3 Type M ____ Contr. Ditch ____
Design Q 23 C.F.S. Frequency 50 Yr. Design High Water Elev. 751.8 Depth 3.4 Ft.
Design Fill Height 7 Ft. Pipe Class 2000 D. Class Bedding C — ADT = — VPD
Disposition of Present Structure —
Remarks F = 30', 5° bend (RF-13)

Computations

	Left		Right	
1 Profile Grade Elev.	4527+40	756.64	4527+65	756.31
2 Vert. Drop {Subgrade or Hinge Point		- 5.0		- 5.0
3 Working Point Elev.		= 751.64		= 751.31
4 Flow Line		- 748.4		- 740.8
5 Difference		= 3.24		= 10.51
6 (D + "T") or (H + Hdwl.)		- 2.3		- 2.3
7 Difference		= 0.94		= 8.21
8 Slope (6:1, 3:1, etc.)		× 3		× 3
9 Working Point to End of Foreslope		2.8		24.6
10 Dist. = ¢ to Working Point		+ 40.0		+ 24.0
11 (1½:1) or (Dimen. "B")		+ 3.6		+ 3.6
12 Length, Calc. or Min ( )	16+20+3.6= 39.6'	46.4	20+3.6 23.6'	52.2
13 Secant of Skew Angle	20°	× 1.06	20°	× 1.06
14 Length on skew		49.4		55.3
15 Add for hdwl. skew		+ —		+ —
16 Length	Use →	50'	Use →	56'
17 Length pres. struct.		- —		- —
18 Extension		—		—

Guidelines for Using the 1000-Series Drainage Structure Typicals in Office of Design's Details Manual (Green Book)

The following remarks should be considered when designing pipe culverts. Pay careful attention to the graphics and notes listed in the 1000-Series of the Green Book. A common mistake made when designing culverts is not listing all dimensions in the Remarks space on pink sheets. Also, needed items such as the angle of bends or RF-14 connected pipe joints are often forgotten and not placed in Remarks. These items plus many others on the pink sheet are necessary to properly complete the culvert tabulations in the road plans. Discussion is also provided for Typicals 4304 and 4311 for foreslope shaping at culverts.

Type 1101

This is used primarily for concrete pipes under pavements. See 1601 for Unclassified pipes under unpaved sideroads and entrances.
Note that "Lt." and "Rt." are to end of apron. "Length" of pipe section is Lt. + Rt. minus apron lengths.
May be used without aprons (e.g., temporary pipes).
Must specify material such as concrete, CMP, or PEP.
If RF-1 (concrete) is used, RF-14 type 3 connected pipe joints must be specified in Remarks.
If RF-1, use 2000D (100D) as a minimum under paved roads.

Type 1102

Teed pipes are generally not recommended except in a side ditch outside the clear zone.
Same comments as for type 1101.
Specify G_1 dimension and indicate size of tee. See RF-21 for description of tee. Must note tee in the Remarks space of pink sheet. Also, tabulate G_1 in Remarks space.
Type 1504 is similar except it has a half-round flume.
See also type 1202.

Type 1201

Normally used with concrete pipe. See type 1401 for a similar culvert as a sideditch letdown and type 1602 for an unpaved road.
May be used as a cross road pipe if the slope of an 1101 would be steeper than approximately 5%. If the fall across the roadway is greater than approximately 8 feet (2.4 m), or if the fill above the bend is greater than approximately 10 feet (3.0 m), consider using type 1501 for ease of construction.
Gradient of pipe beyond bend should be less than 1%.
Needs RF-14 connected pipe joints (type 3).
Specify length "F" and desired bend type and bend angle in Remarks space.
See "special note" on standard RF-13, especially on large pipe.
Use an elbow if the bend is more than 10 degrees. Tabulate bend in Remarks.

Type 1202
Generally used in conjunction with types 1102 or 1504.
To be used as the inlet to a crossroad pipe when all the flow is coming down a steep sideditch (slope greater than approximately 4%). This inlet will prevent the sideditch water from bypassing the inlet and overtopping the adjacent ditch block and will allow the sideditch water to "turn the corner" within the pipe.
Tabulate pipe cap, if needed (RF-21) in Remarks.

Type 1301
Commonly used to extend existing structures.
Length Rt. & Lt. is measured to end of apron.
Length of pipe = A + B, **not** Lt. + Rt.
Tabulate A and B in Remarks space.
When extending a pipe with a pipe, if the slope of extension is different from the slope of existing pipe, RF-2 type C-1 connection will be required. Tabulate RF-2 connection in Remarks space.

Type 1302
Commonly used to extend existing structures.
Skew angle of extension is different than skew of pipe. The extension skew is referenced to the existing pipe, not the centerline of road, e.g., bend is 15 degree Rt., not 15 degree Rt. ahead.
Note on the pink whether skew is the pipe skew or the extension skew.
If the extensions on both ends of an existing structure are skewed, note in Remarks how much each extension is skewed, e.g., "Right end or outlet is 15 degree Rt., Left end or inlet is 20 degree Rt."
May need RF-2 type C-1 connection if the slope of the pipe extension is different the existing pipe.
Need to tabulate RF-14 pipe joint connections for RF-1 extensions.
Use an elbow if the bend is more than 10 degrees. Tabulate bend in Remarks.

Type 1303, 1304
These Typicals may be used for extensions if the slope of a straight extension would be greater than approximately 5%.
Tabulate A, B, C, D, and E and degree of elbow in Remarks.
The flowline of the elbow should be at or slightly above natural ground elevation.
The flowline of half-round pipes should be approximately 3 to 5 feet (1.0 to 1.5) m below natural ground at its terminus. This allows a natural scour hole to develop.
See type 1302 for skew note.
RF-14 type 3 pipe connectors must be noted in Remarks.
The diameter of a half-round is limited to 42 inches (1050 mm).
Maximum "B" = 24 feet (7.3 m). Lengths greater than this tend to settle, resulting in separated joints.
Using Type 1305 is often a good alternative to 1303 and 1304.

Type 1305

Commonly used for extensions.

Designer must select either CMP or PEP for the outlet portion of the pipe.

Tabulate A, B, C, D, E, elbows, and RF-2 adapter in Remarks.

Minimum "C" = 2 feet (0.6 m).

The connection between the concrete and corrugated pipes should extend beyond proposed shoulder line. The flowline at this point should be approximately 6 feet (2 m) below shoulder elevation.

Specify elbows to nearest degree.

Length "B" portion should be approximately parallel to foreslope.

The minimum earth cover is shown as 2 feet (0.6 m). The desirable cover is equal to the diameter of the pipe, e.g., a 42-inch pipe should have approximately 42 inches of cover. This helps resist uplift forces.

Outlet aprons are not always necessary if the outlet draw is steep. Aprons may separate from the pipe if a scour hole develops.

Type 1401 & 1403

Should be used for a side ditch letdown. See types 1201, 1501 and 1503 for paved roadways and type 1602 for unpaved roadways.

Note that the Location point is at the inlet of the pipe, not at the centerline of dike or roadway.

Dike (see standard RL-4) over letdown should be Type F, with a 20 foot (6 m) top width for structures 48 inches (1200 mm) and larger.

Maximum size is 60 inches (1500 mm) to prevent uplift of the CMP inlet. For larger culverts consider using concrete pipe or box culverts.

Outlet aprons are optional if outlet is next to RCB.

Tabulate elbows, diaphragms, A, B, & C in Remarks.

Dimension elbows to the nearest degree.

Length "B" portion should be approximately parallel to the fill slope over pipe on type 1403.

Minimum cover over length "C" is 1 foot (0.3 m). The minimum earth cover over length "B" is shown as 2 feet (0.6 m). The desirable cover over "B" is equal to the diameter of the pipe, e.g., a 42-inch pipe should have approximately 42 inches of cover. This helps resist uplift forces.

Type 1407

May be used when inlet elevation must be lowered due to limited available earth cover.

Maximum height of the wall is dimension "A" on the RF-3 standard for aprons.

Tabulate in the Remarks space the number and size of planks required.

Type 1501 and 1503

See comments for 1305

For type 1501, designer must select either CMP or PEP for the outlet portion of the pipe.

On pink sheet: Tabulate concrete pipe in the space (Pipe _____ + ____Aprons). Tabulate CMP or PEP in the space (Flume ______), but revise this space as (CMP/PEP ______ + ___Apron) or (Half-round Flume_____).

The flowline of half-round pipes should be approximately 3 feet (1 m) below natural ground at its terminus. This allows a natural scour hole to develop.
RF-14 type 3 pipe connectors must be noted in Remarks.

Type 1502
Note that the location point is at the inlet. This culvert is generally used in a side ditch.
If CMP is used, need type "A" diaphragm.
Outlet structure not required.

Type 1504
Type 1102 is similar except it does not have a half-round flume.
Teed pipes are generally not recommended except in a side ditch outside the clear zone.

Type 1601
Unclassified pipes are used under unpaved sideroads and entrances. See type 1101 for paved roadways.
Note that the length Lt. & Rt. is to end of the pipe section, not to the end of the aprons.

Type 1602
Use when a bend under an unpaved road is needed. See type 1201 for a similar culvert under paved roadways and 1401 for sideditch letdowns.
Unclassified pipes are used under unpaved sideroads and entrances.
Tabulate bend in the Remarks space.
Type “A” diaphragms are not required when type 1602 is used under a roadway since “piping” is much less likely due to the length of pipe under fill and possible better compaction of bedding and backfill.

Typical 4304 and 4311
Typical 4304 should be used for all culverts where the calculation point is between the subgrade and the hinge point. Typical 4311 is used only when the calculation point is below the hinge point and when the culvert project is the only work being done, i.e., the existing foreslope will be changed only in the vicinity of the culvert. 4311 (and dimension W) should be specified in the Remarks column on the pink sheet. Typically, W may be given as three times the culvert width.